Fig. II. is the same view, taken immediately after I., but with the polariser opened a little.

Fig. III. was taken after the slide had been treated with Canada balsam and benzene, and allowed to stand five days fixed in the microscope. The benzene and Canada balsam gradually diluted the solvent and brought back the anisotropism of the nitro-cellulose fibres.

The magnification in all photos was × 50 diameter, and the exposure in I. and III. was in each case twice that of II.

In Fig. I. it will be observed that a little light is active besides the crossed cotton fibres. This is more noticeable in the negative. As a matter of fact, with this strength of acetone the anisotropism is just evanescent in a percentage of the fibres.

A comparison of Figs. II. and III. shows that nearly all the fibres seen in II. are anisotropic in III. The fibres obvious in

FIG. III.

II. and not evident in III. lie in the plane of polarisation. The fibres obvious in II. and III. are isotropic in I.

I leave the correct interpretation of these experiments to competent biologists. To me it seems probable that the anisotropism of fibrous cellulose is due to a strain put on the fibre by the tension of the most outward layer of the cell-wall, and that a medium such as here described lessens this tension, whereas ordinary inhibition does not. Some such a theory as the above seems necessary to account for the different action of solvents which swell organised structures. This view is a modification of Strasburger's theory, as I understand it, and would be independent of whether cell growth takes place by lamellæ or particles.

F. W. JONES.

Barwick, Herts.

School Science and Knowledge-Making Power.

THE lecture of Prof. J. G. Macgregor, as reported in NATURE, of December 14, is of very great interest to science teachers, more especially to those in secondary schools. It will afford great comfort to the still very large number of controllers of the curricula in such schools who do not really sympathise with, nor believe in, the good results obtained from scientific teaching. As one who has to deal with all ages of pupils in a large school, may I be allowed to make a few comments on Prof. Macgregor's lecture as it strikes a science teacher?

In class work it seems that the lower forms, when watching an experiment performed before them, are quicker to put one thing with another, and to be led to explain or suggest explanations of the results obtained. This is apparently in accordance with Prof. Macgregor's opinion, that younger pupils have a greater knowledge-making power.

Thus a class of boys, whose ages range from seven to nine years, is much more ready to ask and answer questions concerning the subject of the lesson than classes towards the middle of the school.

The reluctance shown, or the difficulty felt, by higher classes in answering or suggesting questions is considered by Prof. Macgregor to show a lessened power of knowledge-making possessed by them. But even if the science teaching is, throughout the forms, of a constant character in its aim of bringing out the inquiring spirit, in my own experience the same thing is noticed. Can there be another explanation? As boys grow older they are more careful not to make such mistakes in their verbal answers as would lead to the slightest ridicule on the part of their class fellows. Thus, by remaining silent, they give one the impression that they are not following the work with the ability shown by their juniors. Again, with increased experience, questions do not appear so simple in their nature; alternative explanations are suggested to the boy's mind, and the choice is difficult to make. It is possible that the few suggestive solutions offered by a higher form show more power than the many more obvious ones given by the lower form.

Prof. Macgregor says that at present Latin is the only subject which really brings out this knowledge-making power. Surely this is comparing the results obtained from the best classical teaching in small selected forms where each boy is really known to have done his work to the very best of his ability, with the results from science teaching of a very old-fashioned kind, in which the lesson, given to a large class, is of the nature of a lecture. Such a comparison may be made to the disadvantage of any educational subject. It is still the custom in some classes to learn Euclid's propositions by heart! Yet no one would think of displacing the subject on this account.

Referring to the difficulties of increasing the knowledge-making powers of boys, certain enemies are mentioned. There is the use of synoptic or cram-books, which has been found to be necessary to push pupils through examinations in which "knowledge is power" is held as the maxim. Such books, after all, only take the place of written notes of lectures given to the highest forms, and have the advantage of saving the pupil's time. Further, text-books do not all consist of this kind of publication; in fact, some of them are as interesting to an intelligent boy as one of the ordinary run of story-books. Properly used, text-books are of great value surely in this way: the whole attention of the scholar is directed to the demonstration, and after the lesson the book is used to refresh the memory, which it does, not simply by repeating the results, but also the deductions from the results and the necessary steps of reasoning involved.

Prof. Macgregor objects to text-books which contain details of practical work to such an extent that the pupil is told what to do, what to expect, and the reasons why. If the teaching is carried out under such a system as that referred to as the Heuristic, then in the practical text-book it is not necessary to include all these details, but some appear to me to be absolutely necessary. Teachers know well enough the difficulty of getting printed instructions accurately carried out; and certainly letting even a small class of moderately steady boys loose into a laboratory would give the controller of the laboratory an anxious time. If, then, instructions are needed, why not print them? They must otherwise be written on the blackboard, or be of a verbal nature—the latter involving many repetitions.

The best chance that practical science (of course, commenced as early as possible) has of producing knowledge-making power, appears to be in the opportunity it affords of solving questions in a manner closely following an experiment previously carried out. In this connection modern science teaching combines the advantages of the study of propositions in geometry and riders thereon, with employment, simultaneously, of brains and hands. Now an experiment previously carried out implies instructions given.

The other enemy referred to by Prof. Macgregor is the examination syllabus. It is certainly difficult under the best of circumstances for a teacher to go completely through, say, the Cambridge local examination syllabus in science on the Heuristic system, in the time usually allowed by school time-tables. With such a task in front of him the teacher is bound at times to descend, so to speak, to dogmatic teaching. The modern syllabus, both in this examination and in that for the London matriculation, covers so wide a ground that there is danger of the work becoming of the same character as it is said to have been under the older syllabuses. It would appear, even now, to be absolutely necessary to use "synoptic books" when such lengthy syllabuses are prescribed and written examinations held.

But it is hard to see how even a practical examination can test the knowledge-making power of boys when a lapse of

memory may prevent the performance of a measuring experiment, *e.g.* in the recent Cambridge local examination one simple question, to find the area of an ellipse by two methods, is a very admirable question, but presumably one-half the marks allotted are lost should a candidate forget the formula πab.

And, again, it was required to find the specific heat of a liquid by a non-mixing method. Why should this restriction have been made? The practical exercise is sufficiently difficult without any restrictions as to the process employed.

It is only fair to the science teachers in schools to call attention to this side of the question of knowledge-making power in boys, and, instead of merely saying that few teachers have the necessary inspiring spirit, to point out the hindrances with which they have to contend, as Prof. Macgregor has done.

G. H. WYATT.

Emmanuel School, Wandsworth Common, S.W.

Echelon Film Gratings.

MANY of your readers will doubtless be interested to learn that Mr. T. Thorp, of Manchester, who has so successfully reproduced copies of Rowland's gratings, has been able to make an "Echelon" grating on the principle suggested by Prof. A. A. Michelson last year, but stated to be well-nigh impossible on account of mechanical difficulties. The success of the operations depends on the shape, depth, and spacing of the grooves, and after many calculations and preliminary trials Mr. Thorp finds he can produce echelon films throwing the *whole* of the light into the first, second, or other requisite order, the direct image being practically suppressed. The first successful films made in this way were obtained in November last, and it is hoped that in a short time several will be available for examination. If permanent, they should be capable of giving star spectra with the same facility as prisms.

Royal College of Science, S.W. CHARLES P. BUTLER.

The Stockholm Fisheries Conference and British Fishery Investigations.

IN my letter published in NATURE of January 4, I attributed to the Government a larger grant in aid of the fishery investigations of the Royal Dublin Society than was actually given. My friend Mr. Holt informs me that, of a total sum of 2800*l.* originally provided for the work of the Marine Laboratory for five years, the Government only supplied one-half, viz. 1400*l.*, the remaining 1400*l.* being voted by the Society out of its private funds. It being found impossible to carry out the work satisfactorily with such small funds, the Society has recently voted a further sum of 500*l.* for the purchase and equipment of a fishing boat. My contention that existing institutions should be adequately supported before Government money is employed for starting a new organisation is therefore considerably strengthened.

E. J. ALLEN.

The Laboratory, Plymouth, January 12.

THE REPRESENTATION OF THE UNIVERSITY OF LONDON.

IT would seem that the University of London is in some danger of missing a great opportunity in connection with the vacancy created in its representation by the elevation of Sir John Lubbock to the Upper House.

Our readers need not be reminded that the theory on which the representation of academic bodies in Parliament is based is often assailed by politicians and thinkers, and is only tenable on the assumption that those bodies may be trusted to select persons of special eminence in science or learning, and qualified to obtain the confidence of the nation as representatives of its higher educational interests. This principle has been kept in view by Dublin in its choice of Mr. Lecky, by Cambridge and Oxford in the choice of Prof. Jebb and Sir W. Anson, and by the University of London so long as it was represented by Mr. Lowe and Sir John Lubbock. Unless men of higher intellectual rank than mere politicians are sent to the House of Commons by the Universities, there would no longer be any *raison d'être* for University representation at all, and in a democratic community the privilege would not be likely to survive long.

It appears now that there are two small Committees—the one Liberal and the other Unionist—which seek to control the Parliamentary elections of the University; and that on this occasion, instead of heeding the larger public interests involved in a University election, each caucus has been content to nominate one of its own active members, though wholly unknown to the learned and scientific world, or indeed to the general public.

Dr. Collins, the nominee of the Liberal party, took a very distinguished degree in medicine and surgery; has been prominent in the domestic controversies of Convocation, and has been for a time a member of the Senate. Outside of the University he is known as a man of great ability and promise, who achieved marked success as Chairman of the London County Council. But he is considered very unlikely to secure the adhesion of the medical or the scientific graduates.

Mr. Edward Busk, the Unionist candidate, is less known to the outer world. He has a creditable reputation in his own profession as a solicitor, and also as Sir John Lubbock's election agent. As chairman he has paid assiduous attention to the meetings of Convocation and of the annual committee: and has come to be regarded by a certain section of the members—especially by those who opposed the recommendations of the Royal Commission and the University Act—as in some way a guardian of the interests of the country graduates. But his supporters do not claim for him that either in the departments of scholarship and science, or in general academic or educational politics, he has yet evinced any interest or is known to possess any authority or influence.

The fact that both of the Committees, with their special command of electioneering apparatus, have been able to gain a start in point of time, and in some cases to secure provisional pledges, ought not to conceal from the general body of graduates the gravity of the present crisis, or prevent them from acting with due care and circumspection and a strong sense of responsibility in the choice of their member. The truth is that neither of the candidates selected by the named party organisations is of the *calibre* required to fill the seat of Sir J. Lubbock. The election of either would lower the reputation of the University as a learned body, and bring serious discredit on the principle of University representation itself. This has been pointed out with strong emphasis in letters and a leading article in the *Times*, which it is reasonable to expect that the graduates will not fail to consider with attention.

It is to be hoped that before the seat is actually vacated the name of a distinguished graduate may be submitted to the electors—a name not associated with any party politics, but commanding high and general confidence in the scientific and learned world.

ZOOLOGY AND THE AUSTRALIAN MUSEUMS.[1]

ALL who are interested in Mammalian Palæontology and exploration in the Interior of Australia will readily recall the graphic account contributed to our pages in 1894 (NATURE, vol. l., pp. 184 and 206), by Prof. Stirling, of the work of an exploring party sent out to Lake Callabonna, under the auspices of the South Australian Museum, of which he is the Hon. Director, for the purpose of collecting the remains of the gigantic vertebrates of Pliocene age known to be there entombed.

1 "Memoirs of Royal Society of South Australia," vol. i., Part 1. By E. C. Stirling, C.M.G., M.A., M.D., F.R.S., and A. H. C. Zietz C.M.Z.S.

"Fossil Remains of Lake Callabonna." Part 1. Description of the Manus and Pes of *Diprotodon australis*. Pp. 40 + 18 photographic plates.